Serious Accident Investigation
Factual Report

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Freeman Reservoir Fatality
Bureau of Land Management
Northwest Colorado Fire Management Unit
Little Snake Field Office
Craig, Colorado
June 26, 2009

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ACCIDENT INVESTIGATION FACTUAL REPORT

Accident: Freeman Reservoir Tree Falling Fatality

Location: Little Snake Field Office, Craig, Colorado

Date: June 26, 2009

Serious Accident Investigation Team

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Sue E Richardson
Signature **Date**

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Cover Photo: The photo on the front cover is adjacent to the accident scene and represents the training area.

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EXECUTIVE SUMMARY

On June 26, 2009, Brett Stearns, Engine Captain of Little Snake Field Office (LSFO) Engine 1613, was fatally injured as a result of traumatic injury incurred during a tree felling training exercise. This injury was directly caused by a section of tree that broke away from the main trunk during a felling demonstration and struck Mr. Stearns in the head and back.

Mr. Stearns was a 29-year-old male and in good physical condition. He was an employee of the Bureau of Land Management (BLM), Northwest Colorado Fire Management Unit (NWCFMU), LSFO and held the position of Engine Captain. He was an experienced firefighter and a qualified B-level Faller (FALB).

After a normal start to the work day on June 26, 2009, the members of Engine 1613, Engine 1419, and Squad 1 (a five-person initial attack crew located at the LSFO) began their daily activities. The engine captains discussed potentially conducting an afternoon field training exercise in tree felling. The field training would take place at the Freeman Reservoir Recreation Area on the Hahns Peak/Bears Ears Ranger District of the Medicine Bow-Routt National Forest approximately 20 miles northeast of Craig, Colorado. This area had been selected through verbal agreement with Forest Service management as an area providing adequate opportunities for chainsaw use as well as offering an added benefit of hazard tree removal near a public campground.

After lunch, 13 LSFO personnel traveled in two engines and the Squad 1 transport to Freeman Reservoir Recreation Area. After arriving and parking, personnel received a safety briefing and were divided into four training teams, each with a qualified trainer and at least two trainees. Hereafter, the teams will be referred to as either trainers or trainees of their teams. At approximately 1445 hours, the four teams departed the parking area and began working in four separate designated locations for safety.

Training Team 4 consisted of Engine Captain Brett Stearns (trainer) and two squad members as trainees. At approximately 1600 hours, the team had already cut four or five trees using the same process every time. The process included selecting a hazard tree, discussing and evaluating specifics of the tree (lean, direction of fall, branch distribution, etc.), any safety concerns, and falling procedures.

It was at this time that Team 4 approached a large dead aspen tree, approximately 68 feet tall, and selected it as the next one to be felled. The team followed their established procedure and having alternated felling duties between trainees, Team 4 Trainee #2 began the felling procedure using a chainsaw. Trainee #2 moved to the tree and started a horizontal cut, only to stop. Team 4 Trainee #2 stopped cutting and was relieved by Team 4 Trainer. Team 4 Trainer took the saw and Team 4 Trainee #2 moved to a safe location.

Team 4 Trainer began by making a new horizontal cut for the face cut, completing it with the diagonal cut. He then began with the back cut. As the tree began to fall the crown of the dead tree became entangled with a live aspen approximately 95 feet tall. In the process of freeing the

dead tree, the dead tree broke into two pieces and pressure from the live aspen tree, in which it had been hung up, catapulted the upper portion backwards directly toward Team 4 Trainer, hitting him and driving him to the ground.

First Aid and medical evacuation procedures were initiated by BLM personnel on site and local Emergency Medical Services (EMS) personnel soon arrived, as did local law enforcement. After attempting to stabilize Mr. Stearns with no success, he was pronounced dead by the emergency room doctor, via EMS communications, at approximately 1709 hours.

The subsequent Moffat County Coroner's report corroborates that Brett Stearns' cause of death was blunt force trauma caused by the impact of a falling tree.

A Serious Accident Investigation Team (SAIT) was mobilized on June 26, 2009, arrived in Craig, Colorado on June 27, 2009, and began the investigation.

NARRATIVE

Friday, June 26, 2009
(Times are approximate and shown in military time.)

0900 The Craig District engine crews and a five-person initial attack hand crew (referred to as Squad 1 throughout this report) began work. The engine crews went through their daily activities including physical fitness training, daily briefing, and 6 Minutes for Safety. Other duties included breaking down, cleaning, and reassembling the chainsaws and studying training material.

The engine captains discussed potentially conducting an afternoon field training exercise in tree felling.

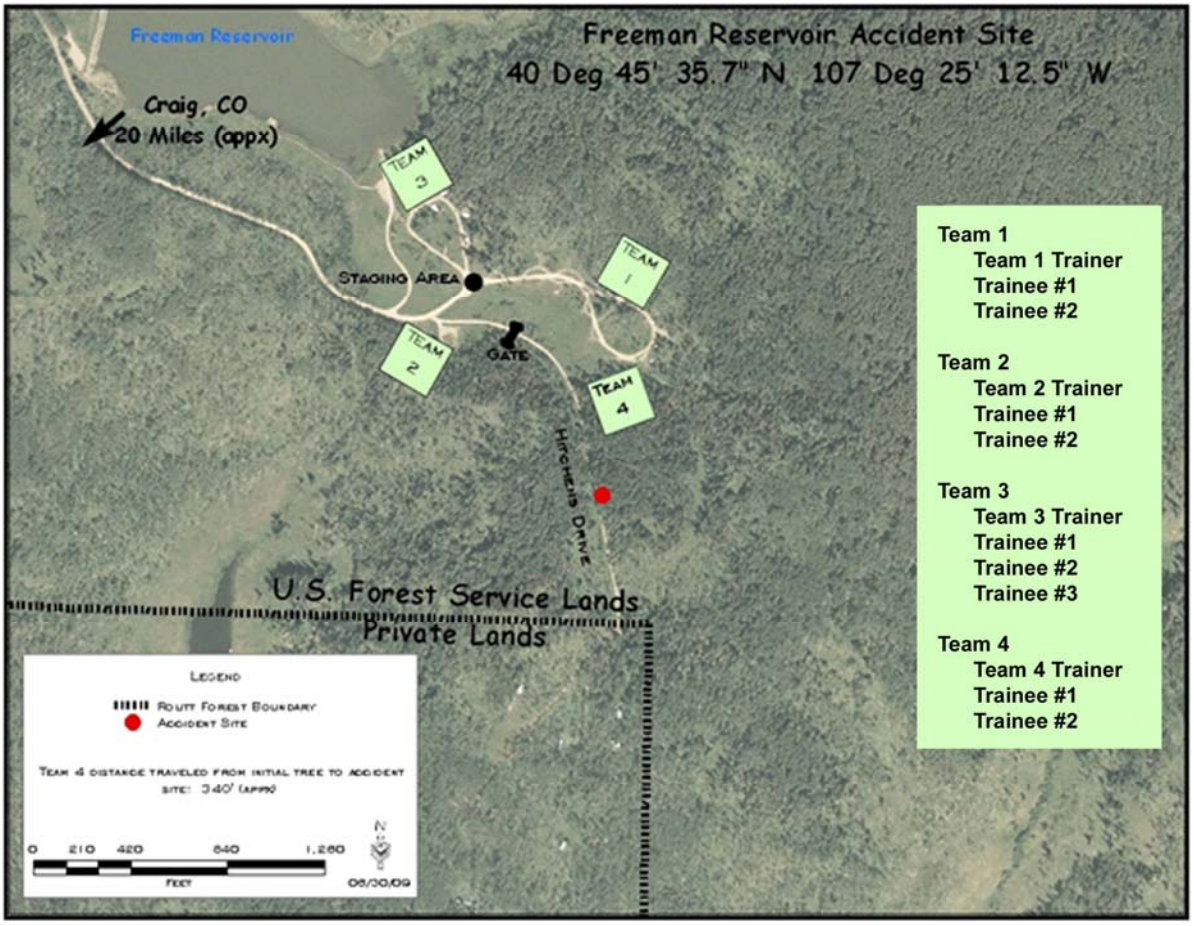
1330 After lunch, the engine captains and Squad 1 leader discussed and agreed to go to the Freeman Reservoir Recreation Area for the tree falling training as it was easily accessible and the weather did not look as threatening to the north of town.

1350 Thirteen personnel departed in Engine 1613, Engine 1419, and the Squad 1 transport for the training area.

1430 Personnel arrived at the Freeman Reservoir Recreation Area. Supervisors organized four teams, each consisting of a qualified B-level Faller (FALB) and a minimum of two trainees not normally supervised by that individual.

1445 After a briefing, the four teams departed the staging area and began working in four separate cutting areas. Map 1 shows the Freeman Reservoir Recreation Area team configuration and general work area.

The four saw teams worked in their designated areas, selecting trees appropriate for training. Before each trainee began cutting, a thorough discussion amongst the team was conducted at each tree regarding proper size-up, safety, escape routes, and other safety concerns. All teams worked separately.



Map 1: Freeman Reservoir Recreation Area Accident Site and Team Configuration

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1600 After having already felled four or five trees, Team 4 approached a large dead aspen tree. The team applied the evaluation process for felling they had used on prior trees. This process included selecting a hazard tree, discussing and evaluating specifics of the tree (lean, direction of fall, branch distribution, etc.), any safety concerns, and falling procedures. The trainees had been alternating being the sawyer and it was Team 4 Trainee #2's turn. The trainees prepared the site and Trainee #2 began putting the horizontal portion of the face cut only to stop. Team 4 Trainee #2 stopped cutting and was relieved by Team 4 Trainer. Team 4 Trainer took the saw and Team 4 Trainee #2 moved to a safe location. Team 4 Trainee #1 stayed in the same location where he was located when Team 4 Trainee #2 was cutting (see Appendix B. Illustrations and Photographs).

It is inconclusive from witness statements on whether Team 4 Trainer used this opportunity to demonstrate felling technique and discussed his actions.

The trainees moved to positions where they could observe and act as spotters, and Team 4 Trainer began cutting. He started by making a new horizontal cut for the face cut, then completed the face cut with the diagonal cut. He then began with the back cut. As he was executing this final cut, the tree fell in the desired direction; however, the crown became entangled with a live aspen, approximately 95 feet tall, that stopped the cut tree from falling to the ground.

Accepted felling safety practices require that once a tree is cut, it must be brought to the ground to remove the hazard. This is usually accomplished by cutting the trunk again in order to relieve the pressure holding the tree in place and allowing gravity to bring the tree to the ground. Team 4 Trainer began this process by moving up the tree and cutting.

This action caused the tree to fall off the stump and simultaneously caused the portion between the original cut and the tension release cuts to split in two and be pushed out to the cutter side. When the tree fell off the stump and came into contact with the ground, the force was great enough to cause the trunk of the tree to break into two pieces, approximately 20 feet up from the second cut. The lower portion fell away from the stump while the top portion and crown, approximately 37 feet, was catapulted by the pressure of the live aspen tree toward where Team 4 Trainer was standing (refer to Appendix A. Felling Operations Subject Matter Expert Report for details).

A warning was shouted and Team 4 Trainer, still holding the saw, was able to take approximately three steps toward his escape route before he was struck in the head and the backside of his body.

1625 The two Team 4 trainees rushed to the unconscious Team 4 Trainer, pushed the top portion of the tree off of his body, and started administering first aid.

Team 4 Trainee #1 put out a radio call over the tactical channel (frequency that the crews were using to communicate at the scene) for assistance and requested immediate help from the other training groups. Two of the BLM crew members who had Emergency Medical Technician (EMT) training hurried to the accident scene, assessed the situation, and began administering first aid.

1630 Team 1 Trainer was first on scene from the surrounding teams. He took control of the accident site, requested medical supplies, directed other personnel, and radioed Team 3 Trainer asking him to call Craig Dispatch and get an ambulance to respond immediately. Team 3 Trainer relayed the request to Team 2 Trainer located at the staging area.

1633 Team 2 Trainer informed Craig Dispatch of the need for an ambulance. He informed them that he would be the communications relay between the EMTs on site and Craig Dispatch.

After a quick assessment of the patient, Team 1 Trainer relayed to Team 3 Trainer to call for Flight for Life due to the severity of the injuries.

1633 Team 2 Trainer notified Craig Dispatch of the need for Flight for Life and passed information on the injured employee's condition as a 29-year-old male with possible back and head injuries.

Craig Dispatch informed Moffat County Sheriff Dispatch (MCSD) of the injuries and requested Flight for Life be ordered.

Craig Dispatch informed Team 2 Trainer that an ambulance was en route and that the MCSD was calling Flight for Life.

1635 Additional team members arrived at the accident scene, including two qualified Emergency Medical Technicians-Basic (EMTB), to assist Team 1 Trainer.

Personnel were directed by Team 1 Trainer to retrieve a compartment door from one of the engines to use as backboard.

Team 1 Trainer requested that Team 2 Trainee #2 get a mouth barrier in case they had to start assisted breathing.

Team 1 Trainer's watch was given to Team 3 Trainee #3, who was one of the qualified EMTBs, to time the vitals of the patient.

Team 1 Trainer remained at the patient's head to stabilize the head and ensure C-Spine protection. At this time they began having difficulty maintaining an open airway. Patient remained non-responsive to stimulus.

Team 3 Trainee #2 and Team 2 Trainee #1 (the two qualified EMTBs) assisted with patient care. Clothing was cut off the patient with medical shears to expose the back and chest to look for additional trauma. Responders noticed a 6-inch area on the back of the right side rib area that was scraped and had light bruising.

1640 Team 1 Trainer reported to Team 2 Trainer that the patient was breathing on his own, non-responsive, and with brachial pulse only. The EMTs continued taking vital signs and continued C-Spine precautions, while other team members fabricated a backboard. Team 2 Trainer checked on status of Flight for Life with Craig Dispatch.

1648 Patient's breathing was deteriorating rapidly. Team 3 Trainee #2 prepared to assist the patient with breathing using a one-way valve mask. Team 1 Trainer noticed abdominal rigidity and continued restricted airway.

1652 Patient had no pulse and C-Spine precautions were being maintained. Chest compressions and assisted breathing were initiated.

Team 2 Trainer notified Craig Dispatch of Team 4 Trainer's condition and asked about Flight for Life again. Craig Dispatch notified Team 2 Trainer that they had no estimated time of arrival on Flight for Life and approximately 15 minutes to estimated time of arrival for the ground ambulance.

The improvised backboard arrived at the accident site and patient was placed onto it and secured.

1655 The local ambulance and EMS personnel arrived on scene as well as two sheriff's deputies from the Moffat County Sheriff's Office.

Deputy Sheriff personnel arrived with an Automated External Defibrillator (AED) and attached it to the patient. A "NO-SHOCK ADVISED" message was displayed by the instrument and no shock was given.

BLM personnel continued to assist with life saving efforts.

EMS personnel took charge of the rescue efforts and contacted the emergency room physician at Memorial Hospital in Craig, Colorado.

1702 Team 2 Trainer informed Craig Dispatch that the sheriff's deputies, EMS personnel, and ambulance had arrived.

1703 Craig Dispatch notified Team 2 Trainer that Flight for Life was standing down due to weather.

1709 The emergency room doctor informed EMS personnel to cease resuscitation efforts on the patient.

The body of the deceased remained at the scene awaiting the arrival of the Moffat County Coroner.

1715 Team 1 Trainer instructed all BLM personnel to gather at the parking area with Team 2 and 3 Trainers for staging.

Team 1 Trainer remained at the accident scene with sheriff and EMS personnel.

1720 All BLM personnel gathered at the staging area while the sheriff's deputies were conducting interviews. Team 2 Trainer asked if Team 1 Trainer and Team 3 Trainer were able to drive the vehicles back to Craig Headquarters.

1721 The Sheriff's Department notified the Moffat County Coroner and requested he respond to the accident site.

1730 Moffat County Sheriff Lieutenant arrived at the scene.

1820 All BLM team personnel departed the parking area and returned to the LSFO headquarters, arriving approximately 45 minutes later.

1830 The Little Snake Field Manager and a BLM Law Enforcement Ranger arrived at the scene. They were briefed on the accident and assisted with the Sheriff's investigation

1900 The Bureau of Land Management SAIT is activated.

1939 The Moffat County Coroner arrived on scene and was briefed by the Sheriff. After the briefing, the County Coroner took possession of Brett Stearns' body and returned to Craig.

1950 A Forest Service (FS) Law Enforcement Officer arrived at the scene. He was briefed by the Sheriff's Deputy at the accident site.

At the completion of the overview and walk-through, the Sheriff released the scene back to the BLM Law Enforcement Ranger and the LSFO Manager.

The BLM representatives collected all pieces of equipment and personal effects from the scene and returned to Craig.

2020 All personnel were clear of the accident scene.

Public access to the site was restricted by two locked gates.

Saturday, June 27, 2009

1200 The SAIT Chief Investigator and Safety Advisor arrive in Craig Colorado. They began the investigation process by traveling to the accident scene in order to familiarize themselves with the location. They were accompanied by a BLM Law Enforcement Ranger and were later joined by two firefighters who were in the training area the day of the accident.

1900 All personnel returned to Craig.

Sunday, June 28, 2009

0800 All members of the SAIT convene and begin the investigation.

INVESTIGATION PROCESS

The fatality was reported to the BLM National Office on June 26, 2009, and a BLM SAIT was mobilized under the delegation of the BLM Assistant Director, Fire and Aviation.

The team consisted of the following positions:

- Team Leader
- Chief Investigator
- Safety Advisor
- Fire Ops/Tree Felling Technical Subject Matter Experts (2)
- Interagency Representative (FS)
- Administrative Assistant/Scribe

Local liaisons in administration, law enforcement, and safety were provided for support by the BLM Little Snake Field Office.

The SAIT Chief Investigator and Safety Advisor arrived at approximately 1200 hours on June 27, 2009, at the LSFO in Craig, Colorado, and began the investigative process by familiarizing themselves with a visit to the accident site. A BLM Law Enforcement Ranger and two firefighters who were on scene during the training exercise assisted.

The SAIT convened on June 28, 2009, in Craig and discussed the investigation process and expectations. After briefing with the Field Manager, his staff, FS personnel, and a Moffat County Sheriff's Deputy, the process of evidence and information collection relating to the accident began.

The process of evidence and information gathering consisted of:

- Visiting the accident site
- Reconstructing the accident site and actions
- Gathering any written statements of events
- Conducting interviews of involved personnel (12)
- Validating training and qualification of personnel involved
- Reviewing time and attendance records
- Considering and evaluating human, environmental, and material factors that may be related to this incident
- Cooperating with requests from other investigative agencies
- Utilizing subject matter experts in Felling Operations to validate actions taken by the deceased

The main focus of this investigation centered on examining the sequence of events based on actions taken by the victim and rescue personnel, eye witness accounts, communication logs, and training/qualifications of personnel.

On June 28, 2009, the SAIT began gathering and evaluating all human, environmental and material evidence and visited the accident site. The SAIT reviewed all communication logs, established a chronology of the accident, inspected the chainsaw and hard hat, and reconstructed the accident site. The SAIT interviewed 10 of the 12 employees that were at the scene the day of the accident. (Two of the employees were unavailable at the time, but were subsequently interviewed by telephone on July 9, 2009.)

A Compliance Officer from the Denver Area Office Occupational Safety and Health Administration (OSHA) arrived at the Craig Little Snake Field Office at approximately 1400 hours on Monday June 29, 2009. He met with LSFO staff and most of the SAIT members and outlined his process for conducting an OSHA investigation of the Freeman Reservoir Fatality. On Tuesday June 30, 2009, three members of the SAIT participated in a site visit with the OSHA representative and some BLM LSFO staff. The OSHA Compliance Officer conducted an informal out-brief with local and BLM Colorado State Office personnel and most of the SAIT members upon their return, and then he departed for Denver.

The SAIT completed their onsite evidence gathering and a rough draft of the report on July 2, 2009. A briefing was held at 1300 hours with LSFO Manager and his staff, FS representatives, and BLM State Office personnel.

The SAIT members were released and returned to their home units.

FACTORS EVALUATED

Factors having a potential impact on this accident were considered and evaluated as to whether they had a direct, indirect, or not significant bearing on the cause of this incident. These factors are included in the table below:

Type	**Discussion**	**Significance to Accident**
Human Factors		
• Fatigue	Time and attendance records did not indicate fatigue.	Not significant
• Situational Awareness	Team 4 Trainer did not maintain visual contact with the tree until it came to rest on the ground.	Significant
	Team 4 Trainer did not reevaluate the time needed to reach the designated escape route from his second cut location.	Significant
• Training	Personnel had completed all required training and refresher courses.	Not significant

• Qualifications	Qualification records indicate personnel were qualified up to the level needed.	Not significant
• Process of tree selection and evaluation	Process for tree selection was discussed and used on all trees cut. Discussion focused on lean, canopy, branch location etc.	Not significant
• Quality of sawyer cuts	Stump and cutout evidence shows that they were precise and well within accepted felling parameters.	Not significant
• Risk Management Worksheet	The existing Risk Management Worksheet did not address tree felling operations and hazard tree removal.	Indirectly significant
• Tail Gate Safety Briefing	A Tail Gate Safety Briefing was used as a Field Risk Assessment prior to starting the training as required by BLM Handbook 1112-2.	Not significant
• Risk Assessment for Hazardous Tasks	No formal written Risk Assessment was completed for felling and hazard tree removal as required by BLM Handbook 1112-2.	Indirectly significant
• Written Agreement for hazard tree removal	No formal agreement is in place between the Forest Service and the BLM for hazard tree removal in this area.	Not significant
• Communications	Communications from the accident site to Craig Dispatch were adequate.	Not significant
• Emergency Assistance Request procedure	Reaction by the Moffat County Sheriff Dispatch to the request for Flight for Life by the BLM Craig Dispatch was not timely.	Indirectly significant
Environmental Factors		
• Weather	Weather had been drizzly but did not hamper operations.	Not significant
• Slope/Terrain	No impact.	Not significant
• Footing	Working area was cleared by felling personnel and footing was not impaired.	Not significant

• Training Area	Area was mixed conifer and aspen growth and was representative of the fire fighting environment.	Not significant
• Severe mortality of aspen stands	Site was selected for chainsaw and felling training due to the close location, the vicinity of a public campground, and the availability of trees that needed removal.	Not significant
• Tree Rot	At the point where the tree broke, there was no indication of rot; although, there was rot where Team 4 Trainee #2 cut and Team 4 Trainer cut.	Not significant
Material Factors		
• Personal Protective Equipment (PPE)	All required PPE for field/project work was being utilized by all personnel during falling operations.	Not significant
• PPE for Felling Operations	All required PPE for chainsaw training and felling operations was being utilized by all personnel.	Not significant
• Hard Hat worn by Team 4 Trainer	The two rear attachment keys were broken off the suspension gear. The four remaining attachment keys appeared undamaged and functioned properly. There was a 1 ½-inch crack in the shell near the right rear suspension key slot. See Appendix C. Hard Hat Inspection Report.	Indirectly significant
• Chainsaw	The saw was operational during the cutting but was damaged by impact with the falling tree.	Not significant
• First Aid Equipment	All equipment was compliant with the standards set forth in the *2009 Standards for Fire and Fire Aviation Operations*, Chapter 14. However, additional equipment which could have been utilized such as a backboard and trauma kit was not present	Indirectly significant

FINDINGS

Findings are the conclusions of the investigation team based on the facts, weight of evidence, professional knowledge, and good judgment. Findings are grouped by category: human, material, and environment.

Finding 1: Human Factor
The unplanned fracture of the tree trunk during routine felling operations, the subsequent catapulting of the upper portion of the tree back toward the faller, his inability to escape the area, and the physical damage as a result of it striking him in the head and back were the direct causes of this accidental fatality.

Finding 2: Human Factor
Given witness statements, site evidence, and examination of cuts on the stump, the SAIT Subject Matter Experts (SME) determined that BLM policy and existing guidelines were generally followed by the faller, but he lost situational awareness by not maintaining visual contact with the tree until it hit the ground and by not re-evaluating the extra time needed to reach the designated escape routes from the second cut location.

Finding 3: Material/Environmental Factor
The existing LSFO Risk Management Worksheet for chainsaw operations was not adequate to address the specific risks of felling procedures or hazard tree removal. A written Risk Assessment was not developed for the hazardous tasks at this site as required by BLM Handbook 1112-2, *Safety and Health for Field Operations*.

OTHER FINDINGS

Other Findings listed below were identified by the investigation team and determined not to be causal or contributing to this accident but would be significant in preventing future accidents or their outcome

Other Finding 4: Human Factor
The agreement between the NWCFMU and the Forest Service Hahns Peak/Bears Ears Ranger District for designating and utilizing areas for conducting chainsaw training is not formally documented nor are protocols identified.

Other Finding 5: Human Factor
The authorities and process for ordering emergency Flight for Life are unclear between the BLM Craig Dispatch office and the Moffat County Sheriff Dispatch.

Other Finding 6: Material Factor
Medical and first aid equipment carried in the vehicles on site met agency requirements but were inadequate for this situation.

Other Finding 7: Material Factor
Personal Protective equipment seems to have functioned as designed.

Other Finding 8: Material Factor
Not all trainees involved in felling training had initiated task books for the level they were being trained.

OBSERVATIONS

The following items were not elevated to "Finding" or "Other Finding" status, and good practices that should be continued.

Observation 1:
The training process and relationship between trainer and trainee was effective in preventing injury to the trainee.

The process set up by Team #4 was logical and allowed for trainer and trainee interaction. This interaction allowed the trainer to take over the actual felling operations when the complexity of the tree was recognized to be beyond the skill level of the trainee. This was a prudent action allowing the most qualified person to complete the felling operation and converting it into a demonstration and a teachable moment for the trainees

It is important to remember that during tree felling training, trainers must ensure that the size and complexities of selected trees are consistent with the skill level of the trainees. The trees selected must be challenging enough for skill development yet within the scope of the trainee's abilities.

Observation 2:
The Freeman Reservoir Recreation Area is suited for chainsaw and tree felling training because it is consistent with the environment found on wildland fire operations.

While any felling operation is hazardous by nature, the felling of dead and dying trees increases the hazard. Therefore extra caution should be used in identifying potential dangerous situations. This increased need for caution is not outside the parameters for wildland fire

The BLM units should continue to train and re-enforce the importance of identification, re-evaluation, and use of escape routes throughout tree felling operations to sawyers/chainsaw operators.

The BLM units should continue to train and re-enforce the importance of maintaining positive visual contact (looking up) when trees are being felled until the tree is on the ground to sawyers/chainsaw operators.

This concludes the report.

Appendix A. Felling Operations Subject Matter Expert Report

On June 26, 2009, Engine 1613, Engine 1419, and Squad 1 arrived at the Freeman Reservoir at 1430 hours for tree felling training. Shortly after arriving, the engine and squad captains decided that trainees would be divided into four teams consisting of a qualified Faller B at a minimum as the trainer. The leaders further decided that the trainers would work with trainees other than their regular crew members to achieve diversification of instruction and evaluation. Providing additional reviews and evaluators strengthens the training process and is consistent with the Position Task Book process.

Team 4 would be made up of a trainer who was the 1613 Engine Captain and two trainees from Squad 1.

Before departing the parking area, Team 4 Trainer conducted a Tailgate Safety Session reviewing the hazards and objectives (training) that the team would be focused on while at the Freeman Reservoir Recreation Area. Team 4 departed the parking area at approximately 1445 hours, heading in a southeasterly direction looking for suitable trees for this instructional period.

Prior to arriving at the tree where the fatality occurred, the Team 4 trainees had cut down four to five trees between them. At this time the weather was overcast with light rain and drizzle. The working conditions were damp but not muddy.

At approximately 1600 hours, Team 4 arrived at the tree where the fatality would occur. All three members of Team 4 observed a large, dead, standing aspen tree that leaned towards Hitchens Drive, a gated road 36 feet away from the tree. During this daily instructional period, both trainees had alternated falling trees; and it was Team 4 Trainee #2's turn to fall the tree. All the Team 4 members discussed and evaluated the tree for lean, branch distribution, and falling procedures. The tree was later determined to be approximately 68 feet tall with a 23-inch diameter breast height (DBH).

Before initiating any falling actions, Team 4 Trainee #2 created a safe working area around the intended tree, as well as removing material in two separate directions for escape routes. All three Team 4 members gathered around after the safe cutting area was created and talked specifically about the two separate escape routes (see B2 photo in Appendix B).

After the tree size-up discussion, Team 4 Trainee #1 moved approximately 22 feet from the Team 4 Trainer (right side of the tree) where he could act as a spotter for the falling operation. Team 4 Trainer moved to a location that was 5 feet to the right side of the tree which was the cutter side of the tree to instruct and observe Team 4 Trainee #2. Team 4 Trainee #2 picked up the saw and moved to the right side of the tree to begin falling operations. Team 4 Trainee #2 started the saw and began the horizontal cut to start the face cut.

Reports differ on why Team 4 Trainee #2 stopped cutting and was relieved by Team 4 Trainer. Team 4 Trainer took the saw and Team 4 Trainee #2 moved to a safe location. Team 4 Trainee #1 stayed in the same location where he was located when Team 4 Trainee #2 was cutting.

The dead tree was the first tree of the day that Team 4 Trainer cut. Team 4 Trainer started the saw and cut the horizontal portion of the pie cut approximately ½ inch below the horizontal cut that Team 4 Trainee #2 had started (see Figure 1).

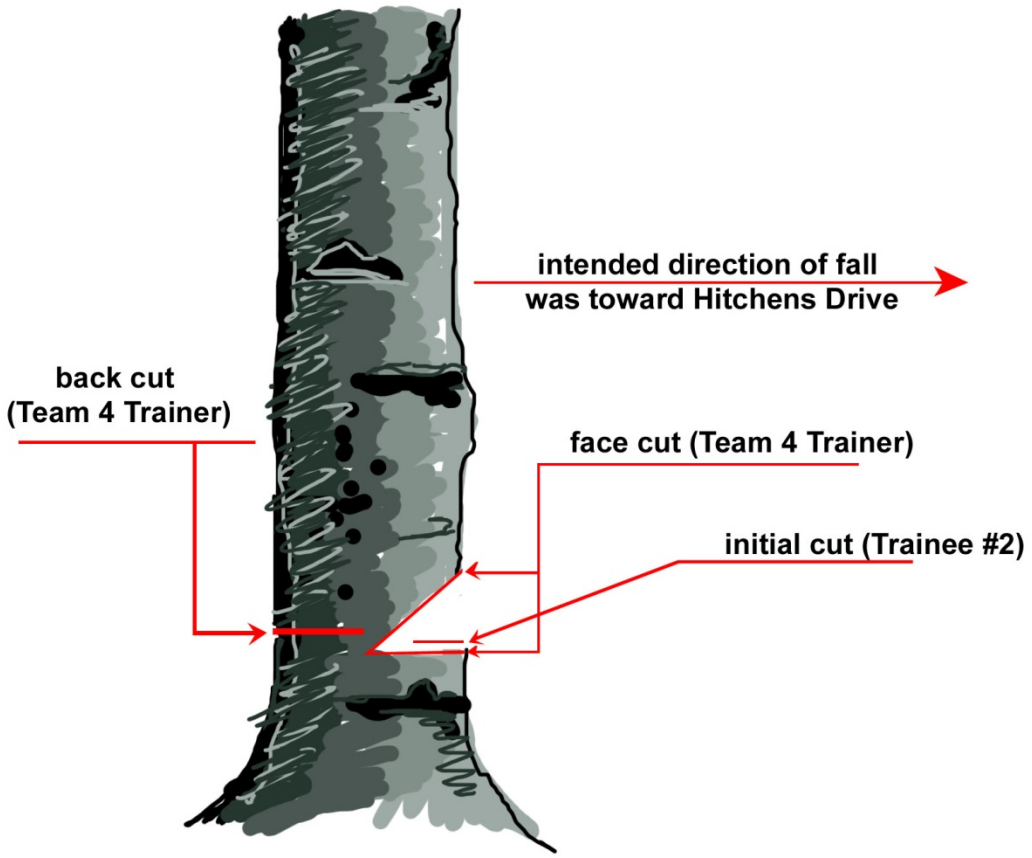


Figure 1: Initial cut made by Team 4 Trainee #2 and subsequent face cut and back cut made by Team 4 Trainer.

The SAIT was unable to determine why Team 4 Trainer dropped ½ inch below the initial horizontal cut. Team 4 Trainer finished the face cut which was well-aligned and had good matching points. Team 4 Trainer removed the cut out and realized that the 23-inch diameter tree was rotted inside and only had approximately 3 inches of solid wood around the outside of the tree (see Figure 2).

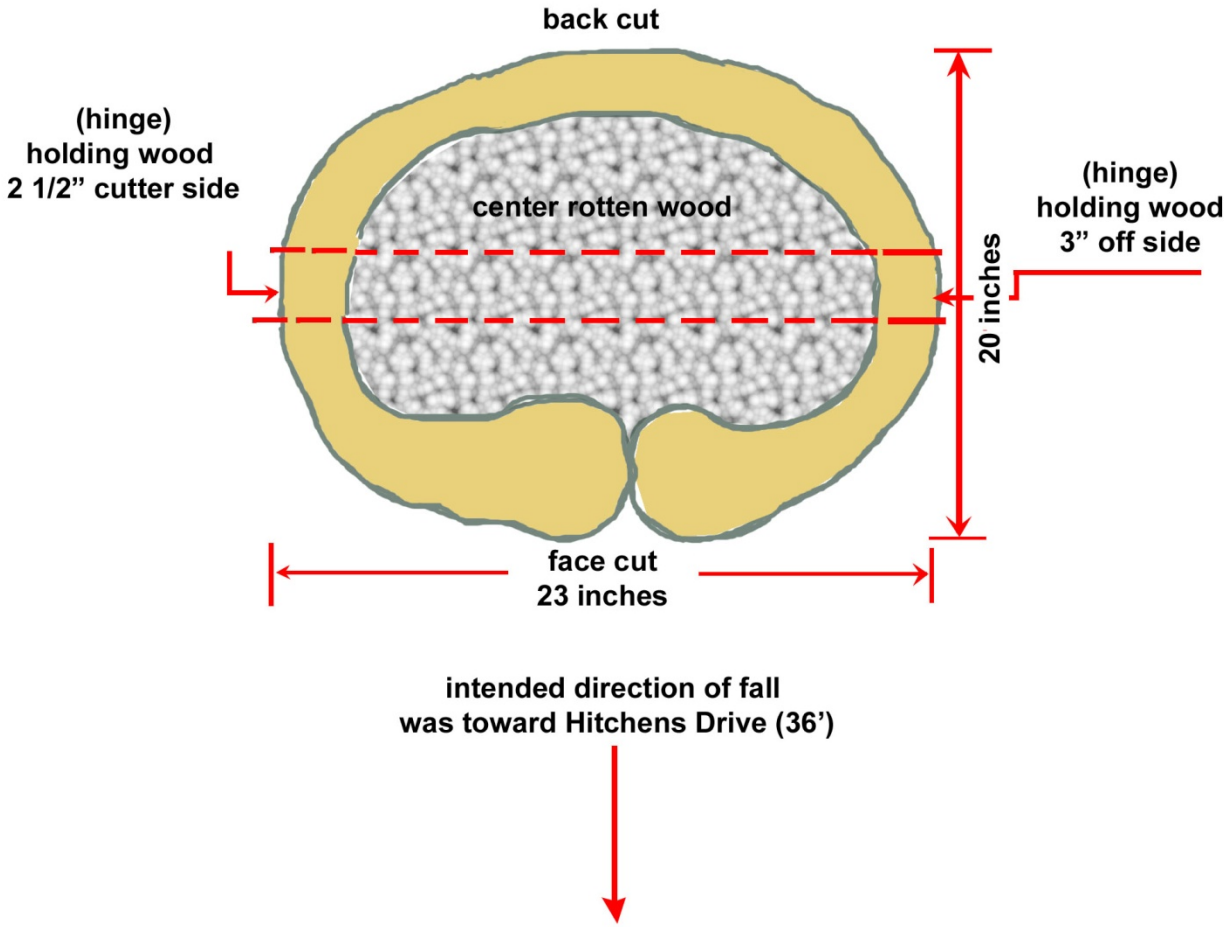


Figure 2: Stump analysis (downward view)

Reports also differ on whether Team 4 Trainer then shut the saw off and took a 4- to 5- minute break to educate both Team 4 trainees on what he had done, the condition of the tree on the inside, and the direction of the fall or only took a momentary pause before starting his back cut.

Team 4 Trainer completed 8 inches into his back cut when the tree began to fall in the intended direction. As the tree started to fall it became hung up when some of the crown limbs got caught up in a live aspen tree that was located 32 feet from the stump towards Hitchens Drive and approximately four feet to the right of the intended direction of fall. This caused the tree to stop falling and remain connected to the stump with approximately 3 inches of holding wood on the off side and 2 ½ inches on the cutter side. The cut tree was securely hung up, in an approximately 95 foot tall, 13-inch diameter, live aspen tree. This live aspen tree bent 5-6 feet under the weight and pressure of the leaning tree until it came to rest against another living tree of the same approximate size.

Team 4 Trainer paused for a brief moment, surveyed the situation, and proceeded to cut the remaining 3 inches of holding wood on the off side in an attempt to free the tree. This action did not cause the tree to fall or untangle from the live aspen tree. Team 4 Trainer moved 1 to 2 feet

along the tree trunk toward Hitchens Drive and initiated a second cut to free the tree from the stump and put the tree on the ground. Team 4 Trainer cut a pie-shaped notch approximately 18 inches above the original back cut to make space for the compression wood on the top side of the tree (see Figure 3).

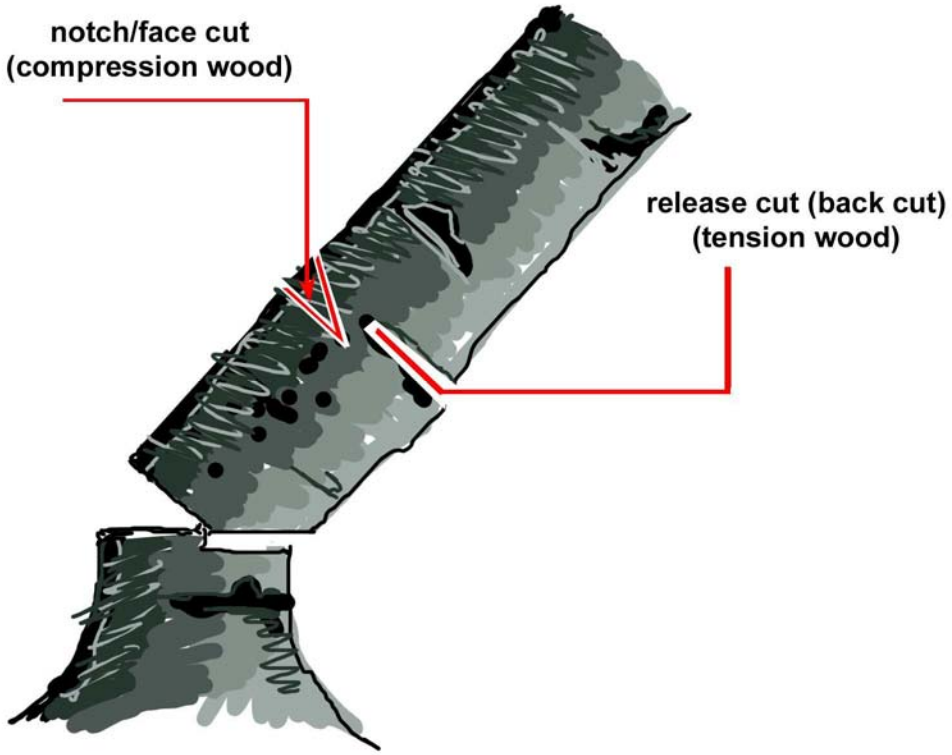


Figure 3: Close-up of Team 4 Trainer's second set of cuts after the tree got hung-up

After the notch face cut was completed, Team 4 Trainer initiated a tension release cut by utilizing the top of the saw bar and coming up from the bottom towards the previous cut. The tension release cut was approximately 3 inches above the flat cut on the notch face cut (see Figure 3). This action caused the tree to fall off the stump and simultaneously caused the portion between the original cut and the tension release cuts to split in two and be pushed out to the cutter side. When the tree fell off the stump and came into contact with the ground, the force was great enough to cause the tree trunk to break into two pieces approximately 20 feet up from the second cut (see Figure 4).

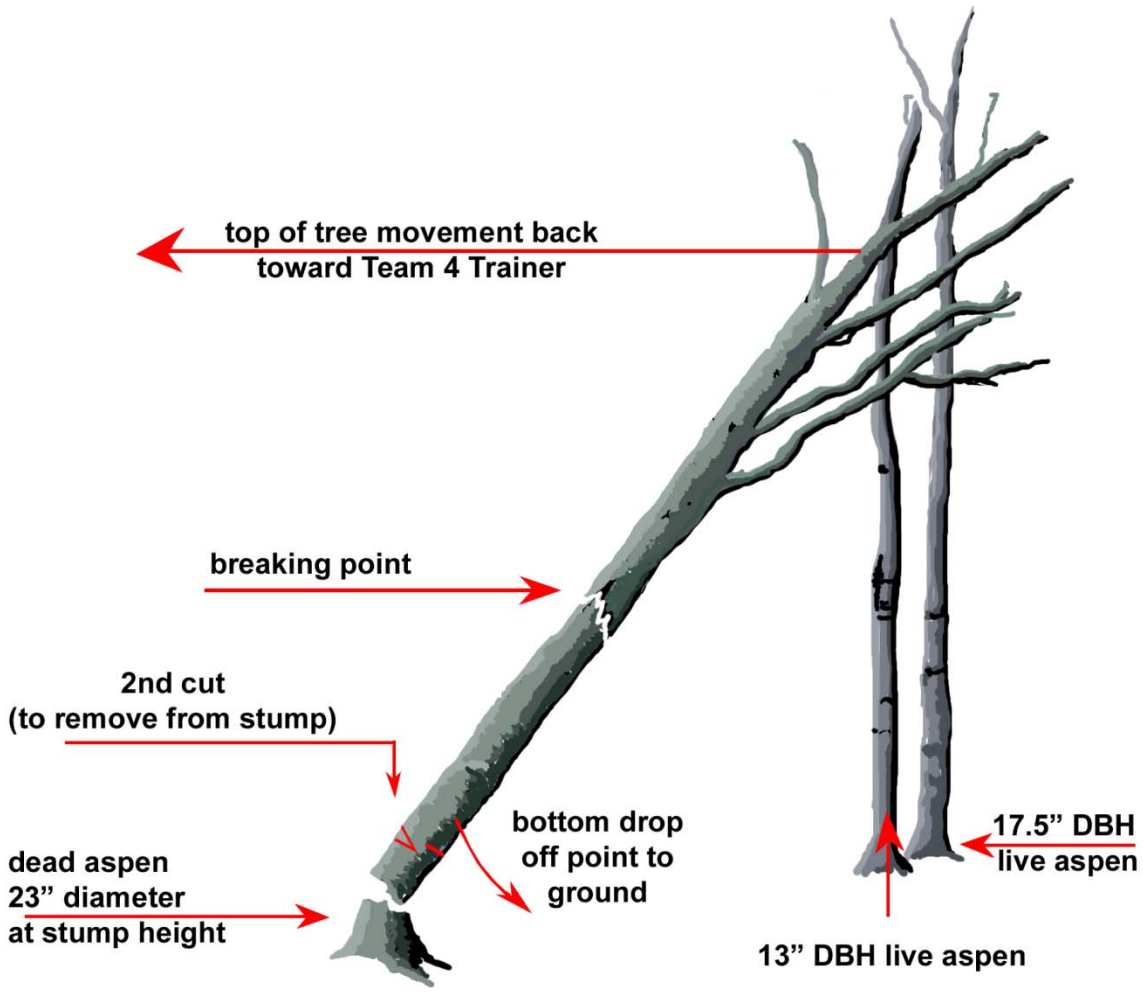


Figure 4: Profile of cutting area showing action of broken top during second cut by Team 4 Trainer

The lower portion of the dead aspen measured 20 feet, 4 inches long; and the upper portion measured 37 feet, 8 inches long. The remaining length of the tree consisted of broken limbs and the stump.

As the tree broke, the pressure on the live aspen that the tree was hung up in was released. Acting like a catapult, the live aspen threw the crown of the dead aspen tree back toward the direction of the stump and Team 4 Trainer's position. As the upper portion came back towards the stump and the Team 4 Trainer, the bottom end of the upper portion was driven into the ground at an angle towards the cutter. When the tree fell off the stump and broke, the spotter Team 4 Trainee #1 yelled at Team 4 Trainer to get out of the way. Team 4 Trainer turned and began retreating in the general direction of the escape routes.

Team 4 Trainer took approximately three steps in the general direction of his escape route. Neither his movement nor his retreat was inhibited by environmental conditions. While retreating in an upright position, with chainsaw in hand, the tree struck the back of his head and body, crushing him to the ground. The impact immediately rendered Team 4 Trainer unconscious and unresponsive (reference Photo 1 below).

Photo A1: This photo shows the location of Team 4 Trainer and the top portion of the tree.

Point A indicates the location of Team 4 Trainer when he was struck.
Point B indicates top portion of the tree (7 ½ - 8 inches diameter) that struck Team 4 Trainer. The tree was moved to this location in order to provide medical assistance to the victim.

Upon witnessing the event, Team 4 Trainee #1 and Trainee #2 rushed to his aid. Team 4 Trainee #2 lifted and rolled the tree off Team 4 Trainer. Team 4 Trainee #1 used the radio to request help from the BLM EMTs on the other saw teams in the area.

Appendix B. Illustrations and Photographs

Photo B1: This photo is a reconstruction of cuts performed in the felling operation.

Point A shows the original horizontal cut made by Team 4 Trainee #2.
Point B shows the horizontal cut made by Team 4 Trainer.
Point C shows the downward diagonal cut made by Team 4 Trainer.

Photo B2: This photo illustrates the designated escape routes established at the start of the felling operations. Point A shows route on the cutter's side and B shows the route established on the offside.

Illustration B1: Tree Felling Sequence of Events (Six Parts)

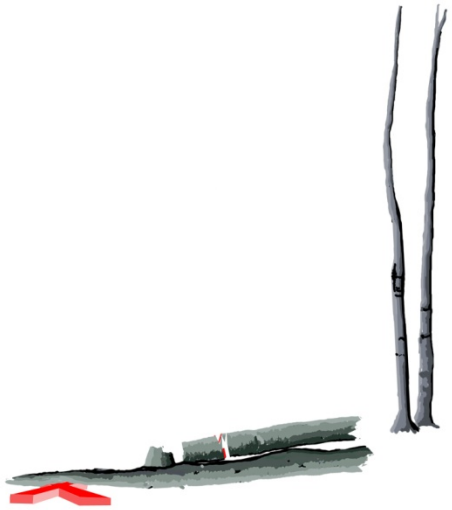
Part One:
Team 4 Trainer finished the back cut and the tree began to fall in the intended direction.

Part Two:
While falling, the tree hung up in a live aspen. The live aspen was pushed and bent approximately 5 to 6 feet by the weight and pressure until it came into contact with another live tree of the same approximate size. Team 4 Trainer cut through the remaining holding wood on the off side in an attempt to free the tree. The attempt was unsuccessful.

Part Three:
Team 4 Trainer moved 2 to 3 feet forward of the stump and began a second cut with the intent to relieve the pressure on the leaning tree and bring it to the ground. As he completed the second cut, the tree came off the stump and the trunk broke into two separate pieces in addition to the butt piece.

Part Four:
The butt section broke and was forced out the cutter side. The lower or bottom part of the tree fell to the ground in the expected direction. The upper piece, however, was catapulted by the pressure of the bent live aspen, back toward where Team 4 Trainer was located.

Part Five:
The top section of the tree fell at an angle towards the cutter. The bottom of this piece hit the ground and impaled itself with the upper part continuing to fall toward the Team 4 Trainer's location.



Part Six:
The upper portion of the tree strikes Team 4 Trainer in the back of the head and back, driving him to the ground, and coming to rest on top of him.

Illustration B2: Overhead View of Accident Site Prior to the Tree Falling

(Not to scale)

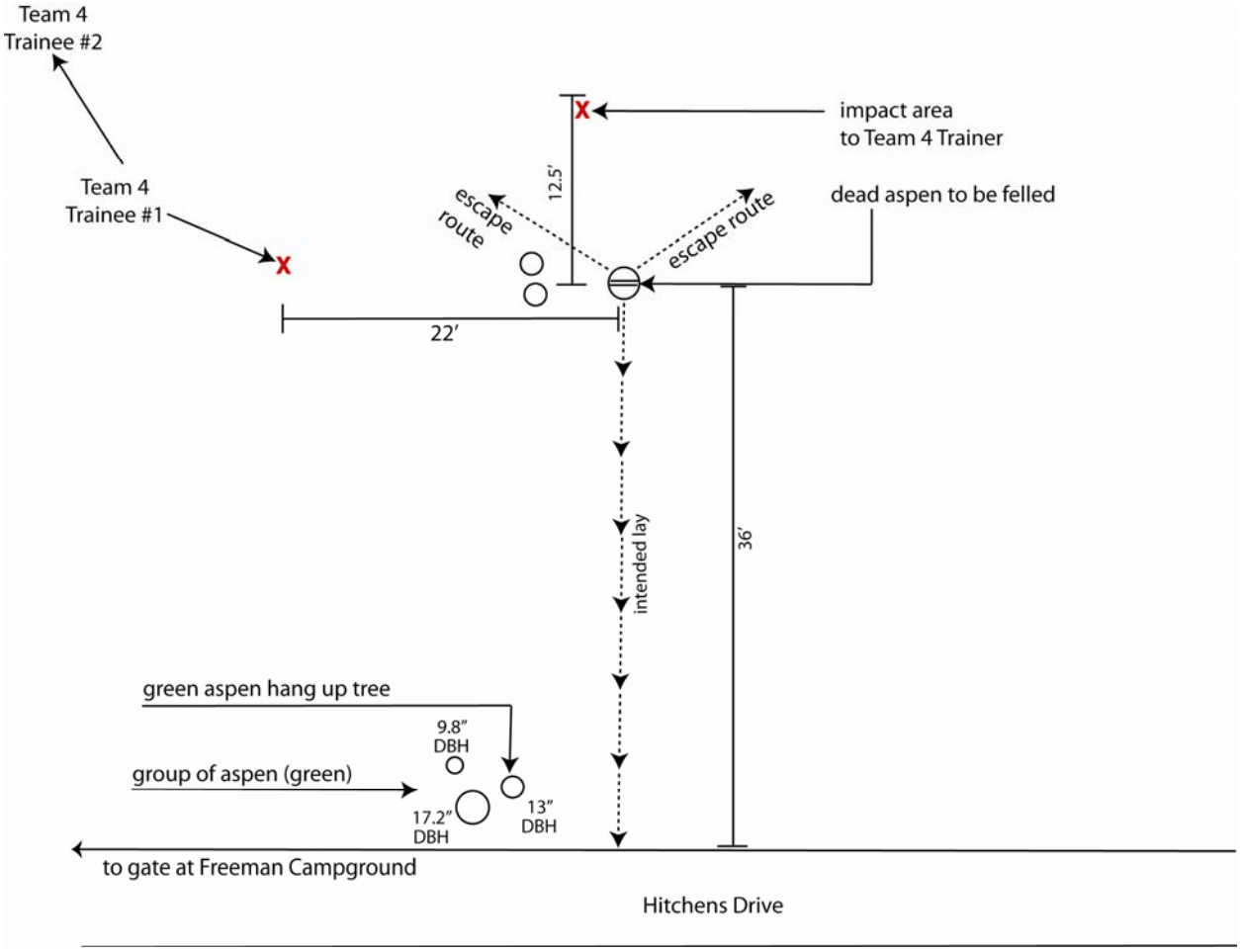


Illustration B3: Overhead View of Accident Site Post Accident (Not to Scale)

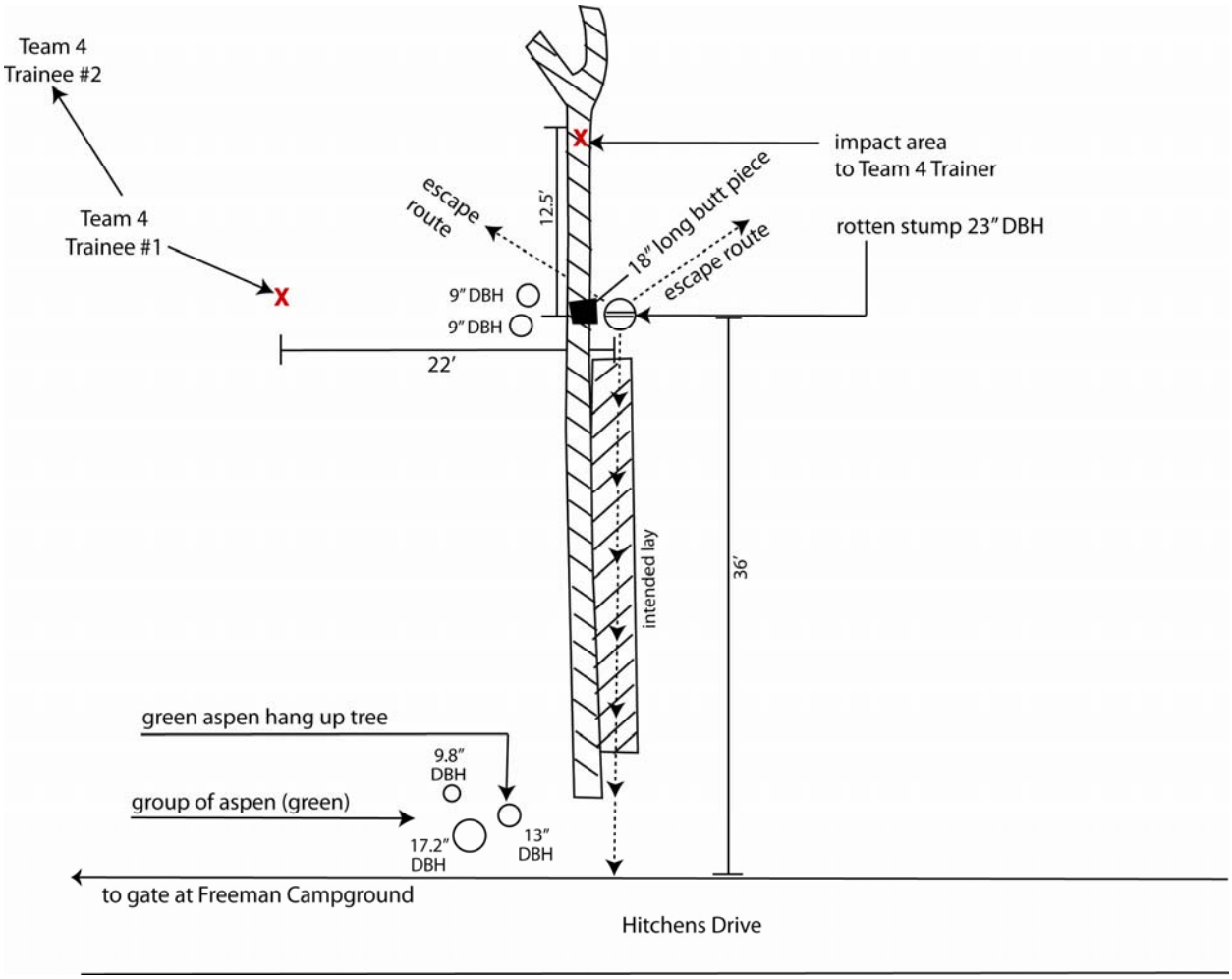
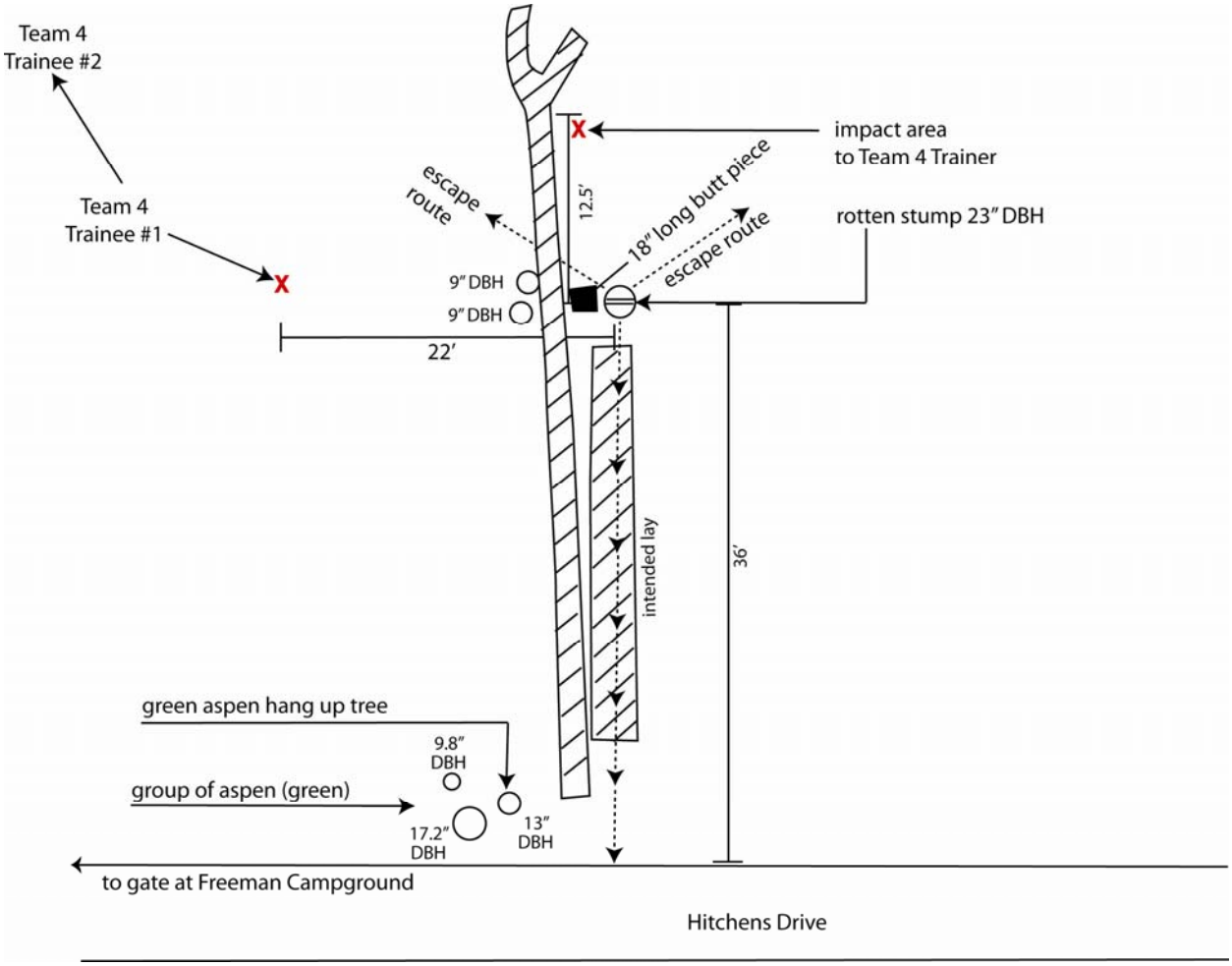


Illustration B4: Overhead View of Accident Site Post Accident with Tree Moved (Not to Scale)



Appendix C. Hard Hat Inspection Report

Submitted by John R. Smith
Equipment Specialist
Missoula Technology & Development Center

On June 26, 2009, Brett Stearns, Engine Captain of the Little Snake Field Office, was fatally injured during a tree felling training exercise. At the request of Stan Palmer, Chief Investigator of the Serious Accident Investigation Team, Brett's hardhat was examined by John Smith of the Missoula Technology and Development Center (MTDC) on August 12, 2009.

Hardhat Data

Manufacturer: Bullard, Model FH911C with Bullard Sure Lock® Suspension
Date of Manufacture: Hardhat - May, 2006; Suspension – July, 2006
Compliance: USTC certified to NFPA 1977-2005 and ANSI Z89.1-2003 Type I, Classes E & C (Figure 1)

Inspection Findings

When it arrived at MTDC the hardhat suspension was clipped into the shell by 4 of the 6 attachment points (key and key slot system). Prior to arriving at MTDC, the suspension had been removed and then replaced in the hardhat, but it was reported that immediately post-accident the two side attachment keys had popped out of their respective key slots.

The only observed damage to the suspension system was to both of the rear attachment keys which were broken off of the suspension (Figure 2). The four remaining attachment keys appeared undamaged and functioned properly to attach the suspension to the shell.

A visual inspection of the hardhat shell revealed only one area of damage. There was a 1-1/2 inch long crack in the shell in the area of the right rear suspension key slot (Figure 3). This crack went through the full thickness of the shell material. Aside from this crack, the shell showed no visual effect of the impact sustained. In overall appearance the hardhat was in good condition with a normal amount of light scuffing and scratching as expected with use. There were no obvious misshapen or deformed areas.

Discussion

The hardhat meets the head protection requirements of the 2009 Interagency Standards for Fire and Fire Aviation Operations (Redbook), Chapter 7. The hardhat appears to have performed as designed. This hardhat was certified as meeting the test requirements of ANSI Z89.1, Type I, which includes a test for protection from top impact. According to the investigation report, the impact received was to the back of the hardhat more than directly to the top. Therefore it would be inappropriate to make any comparison between the impact force received and the impact force specified in the ANSI Z89.1 test procedures. Discussion with the hardhat manufacturer indicated that the type of damage seen to this hardhat was unlike any their lab had seen in the course of

testing to meet the top impact standards as specified in ANSI Z89.1. Lacking additional information concerning the weight of the tree, falling height and strike angle, it is impossible to make any estimate of the impact force in this incident.

Figure 1 – Compliance Label

Figure 2 – Condition of inside of hardhat

Figure 3 – Damage to shell, right rear suspension attachment area